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AGRICULTURAL ENGINEERING RESEARCH DIVISION
AGRICULTURAL RESEARCH SERVICE
U. S. DEPARTMENT OF AGRICULTURE

The Agricultural Engineering Research Division
ARS-USDA

(Its Ups and Downs)
(Alpha and Omega)

By M. Conner Ahrens 1/

Organized agricultural engineering research, as we know it in the U.S. Dept. of Agriculture, awaited the turn of the century before it made its first, small beginning. It was then, after the mad rush of many of our people to settle the West, that there came a clamor for help in the best use of irrigation waters on the fertile, but arid lands. It was in that period too, that the federal government turned over much of the swamp lands in the public domain to the separate states, who, when they attempted to put the land to use, found they needed the knowledge of agricultural engineers to drain these last areas. State experiment stations were getting established and they felt the need for engineering know-how, not only on their own staffs, but in a cooperative relationship with the U.S. Dept. of Agriculture. A depression in the middle 1890's brought a demand from farmers for more labor-saving machinery and equipment to replace the hired hands whose salaries they could no longer afford to pay.

The Beginning of Agricultural Engineering Research

The many economic farm needs finally brought the need for agricultural engineering research into sharp focus in the U.S. Department of Agriculture. Two popular publications issued in 1895 and 1896 were among the first signs of engineering research activity in the Department. One of these, "Silos and Silage," Farmers Bulletin 32, was issued in 1895 and the following year

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"Sewage Disposal on Farms and Protection of Drinking Water," made its appearance as Farmers Bulletin 43. That original Farm Sewage and Water bulletin was the first USDA publication concerned with the subject.

Although Congress in 1890 set up an Office of Irrigation Inquiry in the USDA which ran a 5-year course before it passed out of the picture, it was not until 8 years later that Agricultural Engineering Research really got under way. Agricultural Engineering in the Department as we know it today had its start in 1898 when a division of Irrigation Investigations was established in the Office of Experiment Stations. The first direct appropriation for drainage research from Congress was \$10,000. Elwood Mead was placed in charge of the research. Mead graduated with degrees in civil engineering and agriculture from Purdue in 1882 and had become the first teacher of irrigation engineering in the United States at Colorado Agricultural College in 1886. In 1898 he took charge of the first irrigation research of the USDA.

The Consolidation of Agricultural Engineering Research

Many of the research bureaus of the department carried out their own engineering research as the need arose, and not until pressures of the First World War for cooperation did they give up these independent operations.

Much of the work of USDA agricultural engineers through the first quarter of this century was concerned with education and service as well as research programs. Until the Extension Service was established by Congress in 1914, the educational phases of agricultural engineering were considered as much a part of the work of these men as was their research.

In 1924, Lewis A. Jones, a drainage engineer in the Bureau of Public Roads, became the first part-time extension agricultural engineer to work in close association with the research engineers. He was on the payroll of both The Extension Service and The Bureau of Public Roads as a research drainage engineer. In 1929 S. P. Lyle became the first full-time extension agricultural engineer to work with the men doing research.

Introduction of Housing Research

In 1913, a small section of the Division of Farm Management was set aside to study farm housing. Two men made up the staff. In the next year, 1914, two more men were added. One of these was Wallace Ashby who was Chief of the Livestock Engineering and Farm Structures Branch until his retirement in 1960. Farm housing research got a tremendous boost in 1934 when a survey of farm housing was set up as a federal civil works project. From this came the knowledge of farmhouse conditions throughout the United States as well as the desires and needs of farm families.

Consolidation and Increased Duties

The first World War had a solidifying effect on agricultural engineering research. Because a shortage of personnel brought on a need for cooperation, the other research bureaus of the U.S. Dept. of Agriculture began to make more use of the engineers who were at the time manning the three divisions in the Office of Public Roads and Rural Engineering. In 1918, the Office of Public Roads and Rural Engineering became known as the Bureau of Public Roads and although the status of the engineers did not change, their work was expanded in 1920 when they were given the job of reworking and distributing 120,000,000 pounds of smokeless powder, valued at more than \$8,000,000, the biggest peace-time contract for explosives up to that time.

Refrigerated Transportation of Fruit and Vegetables

Shortly after the end of World War I the engineers cooperated with the Bureau of Plant Industry in studies of transportation of fruit and vegetable crops. W. V. Hukill led in developing instruments for these studies including remote reading anemometers that made it possible to study air movement in a loaded refrigerator car.

Electrification Research

The period shortly after the First World War also saw the beginnings of electrification research by agricultural engineers. Daniels, of the Division of Rural engineering of the Office of Public Roads, wrote the first reports concerned with farm electrification. These appeared in the U.S. Dept. of Agriculture yearbooks of 1918 and 1919.

Fertilizer Studies

In 1924 USDA engineers began research on fertilizer distributing machinery at the request of the National Joint Committee on Fertilizer Application. At first this work was concerned primarily with a determination of the physical characteristics of fertilizing materials when they were exposed to different weather conditions. In 1929, 22 fertilizer distributors and planters with fertilizer attachments were tested in field and laboratory for planting cotton to determine the characteristics of each machine. It was from this project that the research men came to realize that proper placement of fertilizer in relation to crop seed had great importance and the project was rewritten in 1931 to be concerned primarily with placement studies. These fertilizer placement studies continued to the present time including cooperative experiments with approximately 20 states.

Cotton Ginning

Cotton ginning research was started in 1928 and directed for many years by Charles A. Bennet. The Stoneville, Clemson, Mesilla Park, and Lubbock Cotton Ginning Laboratories under the guidance of the Harvesting and Farm Processing Branch have contributed nearly all of the ginning research that has been conducted including information on control of gin air pollution.

Cooperative Building Plan Exchange

The Cooperative Farm Building Plan Exchange originally started in 1933 and later operated under the guidance of the Livestock Engineering and Farm Structures Research Branch incorporated recent research into building plans and distributed them to State Extension Services. This was done in cooperation with Federal and State Extension Services, State Agricultural Experiment Stations and other interested governmental agencies and industry.

Emergency Projects

During the years between World War I and II many different emergency campaigns were started such as those on sugar beet mechanization, European corn borer control, and development of cotton ginning research.

Tillage studies concerned with cotton production were begun in 1931 and ultimately led to the construction of the U.S. Tillage Machinery Laboratory at Auburn, Alabama, in 1935. Work of this laboratory has gained an international reputation. During 1938-41, the investigations of the Tillage Laboratory were redirected to national defense projects. Some of the beach landings made in the war with Japan were facilitated by the use of devices and attachments developed at this laboratory. During 1944-45, the plots and test equipment of the Tillage Machinery Laboratory at Auburn, Alabama, were taken over by the Army for flotation studies of ordnance equipment.

The National Tillage and Machinery Laboratory (NTML) operating under the guidance of the Crop Production Engineering Research Branch has gained world-wide recognition for its studies and industry cooperation in the determination of tractor tire design and traction efficiency, the efficiency and design of tillage tools, and soil-plant root relationships.

Soil and Water Conservation Research Separated from AERD

The then Bureau of Agricultural Engineering suffered a major loss in 1938 when the Divisions of Farm Irrigation and Farm Drainage and Erosion Control were absorbed by the recently organized Soil Conservation Service. Later, these research functions were transferred back to the Agricultural Research Service with the Soil and Water Conservation Research Division.

Increased Emphasis on Farm Electrification

In 1939, USDA agricultural engineers experienced another reorganization when a new Division of Farm Electrification was established. This was first headed up by S. P. Lyle, followed by H. L. Garver. The research was stopped during World War II but was reinstituted in 1946 with Dr. T. E. Hinton as head. In 1946, the Agricultural Research Administration entered into an agreement with REA to conduct research of mutual interest.

The Bureau of Plant Industry, Soils, and Agricultural Engineering

In 1944 Agricultural Engineering research was transferred to the Bureau of Plant Industry and Soils. A. W. Turner was employed to head the Agricultural Engineering work. In 1945, however, the divisions regained their original identity, including farm power machinery, farm buildings, mechanical processing, plant and services, and farm electrification.

Over the years, the division carried out research projects in many areas requiring immediate answers such as pesticide application, castor bean harvesting, sugar cane harvesting, and cotton mechanization. In 1964 the

Agricultural Engineering Research Division of the Agricultural Research Service employed approximately 150 professional personnel. This had not changed very much by 1972 when engineers and scientists in AERD totaled approximately 165.

Agricultural Engineers in Civilian and Military Service

A temporary committee on defense activities was appointed in the fall of 1950 by the ASAE. In May 1951 a subcommittee on agricultural engineers in military service was set up with Dr. T. E. Hienton as chairman. From this came a committee on agricultural engineers' relations in civilian and military service which existed until December 1970 when its missions had been largely accomplished. Principal efforts were devoted to classification of agricultural engineers in the U.S. Department of Labor publication, "Dictionary of Occupational Titles," (DOT) and in ways by which the armed services might best utilize graduate engineers. These efforts were both successful. Agricultural Engineering now carries a comparable placement with other engineers in most of the major lists showing rosters of scientists and/or engineers as published by various organizations.

McKibben Heads Agricultural Engineering Research

In 1952, Dr. E. G. McKibben took over Agricultural Engineering Research except drainage, soil erosion and irrigation. Immediately prior to that time he had been Director of the National Tillage Machinery Laboratory, Auburn, Alabama.

Formation of ARS with New Identity for Agricultural Engineering

In 1953, the Agricultural Research Service (ARS) was formed, replacing the Agricultural Research Administration (ARA) of which the Bureau of Plant Industry Soils and Agricultural Engineering (BPISAE) was a part. With this

new organization Agricultural Engineering operated under Branch identity until 1957.

Agricultural Engineering Becomes a Division

Because agricultural research increased, ARS was realigned in 1957. The Agricultural Engineering Research Division (AERD) was formed as one of six parallel discipline-oriented divisions that made up "Farm Research" headed by a deputy administrator. The Division operated with four branches including:

1. Crop Production
2. Livestock Engineering & Farm Structures
3. Harvesting and Farm Processing
4. Farm Electrification

Phyto-Engineering and Pioneering Laboratories

In the early 60's a Phyto-Engineering Laboratory was established at Beltsville in cooperation with crop scientists. About the same time, a Pioneering Laboratory was established at Wooster, Ohio, to study the Physics of Fine Particles.

Walter M. Carleton, New Division Director

In 1965, with the retirement of E. G. McKibben, W. M. Carleton was appointed to direct the Division. These were somewhat trying times; with diminished surpluses, new challenges appeared. The loss of available laborers increased the need for mechanization. Silent Spring brought a sudden cry for more efficient use of pesticides. Consumerism reared its head in the form of poultry condemnations; air pollution caused by cotton gins; pollution of the soil, water, and air caused by livestock waste; mycotoxins on peanuts; and the need for low-income housing.

ARS Reorganized

In order to reduce the number of lines of administration and to coordinate more research with the State Experiment Stations, ARS was organized in July 1972. Discipline organization identity has been removed by the elimination of the division and branch concept. Project Leaders report to a Research Leader who, in turn, reports to an Area Director who is responsible to one of four Deputy Regional Administrators. The four Deputy Administrators will look to the National Program Staff for technical coordination. Thus, in brief, is the history to date of The Agricultural Engineering Research Division in the United States Department of Agriculture. What will the next 70 years bring?

Some Broad Research Accomplishments

Fruit Harvesting Partly Mechanized

The past twenty years have seen industrial revolutions in the harvesting of fruit. No more than 15 years ago a spokesman for the fruit industry said that if this problem was not solved, many products common to the American family table would disappear or be available only to the affluent families. ARS engineers at Davis, California, developed the mechanical shaker, probably the most universally-used tool for detaching fruit. Often as a companion tool, a catching frame, also developed by the Davis group, is used to collect the product and convey it into a bulk container.

Farmstead Mechanization

ARS engineering research provided information to farmers on concepts and systems to reduce labor costs in livestock production. In some cases, prototype equipment was developed and built to demonstrate the principles involved. Mechanical flat-bottom-bin unloaders and low-pressure pneumatic

feed conveyors are examples of commercially manufactured devices on which ARS obtained public patents.

Fully automatic systems where dairy cattle are fed according to their production have recently been developed by ARS engineers working in cooperation with the University of Illinois. In these systems, automated, preset controls initiate action to remove feed from storage, grind and mix it into any desired ration, and convey it to the livestock. In one system, the quantity to each individual cow can be adjusted to her needs.

ARS engineers also developed principles for complete automatic handling of poultry feed from storage bins to feeders, for measuring eggshell fragility, and for measuring fat and lean in animals with sound waves. The ultimate benefit of this research is to the consumer in the form of lower-cost meat and animal products.

Pest Control Research Expanded

With the clamor to reduce the amount of pesticides being used, the research was increased with so-labeled "pesticide funds." More efficient sprayers were developed. More efficient insect light traps were developed for surveying, sampling, and destruction of economic insects. Traps and technology were developed for controlling the tobacco hornworm in a 314 square-mile-area experiment. Automatic equipment was developed for mass-producing insects and for releasing from aircraft certain insects for control by sterile male technique.

More Cooperative Interdisciplinary Research

With closer inspection and additional condemnations, funds were appropriated for two laboratories to study the effects of diseases and management on poultry condemnations. A team approach was initiated with agricultural engineers, animal scientists, and veterinarians working together.

Housing--A Universal Problem

Farm homes have suffered from lack of adequate farm income for maintenance, repair, and modernization. New work was initiated on, self-help construction, low-cost heating systems, cooling, and housing for the elderly. The bonded block wall building technique was developed, and new standards were formulated for migratory housing.

Field Crop Mechanization

With the worldwide need for more low-cost protein, soybean production established new records. More efficient harvesting equipment was needed to reduce harvest losses. A project was initiated to develop soybean harvesting equipment.

The revolution in corn harvesting in which the corn is shelled in the field brought new processing and drying problems. Time-temperature-moisture relationships were developed to predict safe storage for the new high-moisture corn coming from the field shellers. The development of a double-belt, squeeze-type, thresher principle indicates high success for reducing combine damage of corn.

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